SCIENCE

NEW YORK, APRIL 3, 1891.

THE MARINE BIOLOGICAL LABORATORY.

THE corps of instructors for the fourth season (1891) consists of Dr. C. O. Whitman, director, professor of zoölogy at Clark University, and editor of the *Journal of Morphology;* E. G. Gardiner, Ph.D., instructor in zoölogy Massachusetts Institute of Technology; J. Playfair McMurrich, Ph.D., docent in zoölogy at Clark University; T. H. Morgan, Ph.D., Bruce fellow, Johns Hopkins University; W. M. Wheeler, fellow in biology, Clark University; H. C. Bumpus, assistant professor of zoölogy, Brown University; W. M. Rankin, Ph.D., instructor in zoölogy, Princeton College; Ryoiche Takano, artist; G. M. Gray, laboratory assistant; J. J. Veeder, collector.

In addition to the regular courses of instruction in zoölogy, botany, and microscopical technique, consisting of lectures and laboratory work under the direct and constant supervision of the instructors, there will be two or more courses of lectures on special subjects by members of the staff. One such course of six lectures will be given by Dr. McMurrich on the *Ctenophora* and the *Turbellaria*. Similar courses on the *Mollusca, Crustacea,* and *Echinodermata* will be given by Professor Bumpus and Dr. Rankin.

There will also be ten or more evening lectures on biological subjects of general interest. Among those who may contribute these lectures and take part in the discussions upon them may be mentioned, in addition to the instructors above named, the following: Dr. H. Ayers of the Lake Laboratory; Professor H. H. Donaldson, Clark University; Professor W. G. Farlow, Harvard University; Professor J. S. Kingsley, University of Nebraska; Professor W. Libbey, jun., Princeton College; Professor C. S. Minot, Harvard Medical School; Professor H. F. Osborn, Princeton College; Dr. S. Watase, Clark University; Professor E. B. Wilson, Bryn Mawr College.

The laboratory is located on the coast at Wood's Holl, Mass., near the laboratories of the United States Fish Commission. The building consists of two stories, — the lower for the use of students receiving instruction, the upper exclusively for investigators. The laboratory has aquaria supplied with running seawater, boats, a steam-launch, collecting apparatus, and dredges; it is also supplied with re-agents, glassware, and a limited number of microtomes and microscopes. By the munificence of friends, the library will be provided henceforth not only with the ordinary text-books and works of reference, but also with the more important journals of zoölogy and botany, some of them in complete series.

The laboratory for investigators will be open from June 1 to Aug. 29. It will be fully equipped with aquaria, glassware, reagents, etc., but microscopes and microtomes will not be provided. In this department there are fourteen private laboratories supplied with aquaria, running water, etc., for the exclusive use of investigators, who are invited to carry on their researches here free of charge. Those who are prepared to begin original work, but require supervision, special suggestions, criticism, or extended instruction in technique, may occupy tables in the general laboratory for investigators, paying for the privilege a fee of fifty dollars. The number of such tables is limited to ten. Applicants for them should state precisely what they have done in preparation for original work, and whether they can bring a complete outfit; viz., microscope, microtome, camera-lucida, etc. Special attention is invited to the opportunities here offered, as it is believed that they are somewhat unusual.

For the completion of any considerable piece of investigation, beginners usually require from one to three full years. It is not expected, therefore, that the holders of these tables will finish their work in a single season. The aim is rather to make a safe beginning, which will lead to good results if followed up between sessions, and renewed, if need be, for several successive years. No applications for less than the whole session can be received in this department.

The laboratory for teachers and students will be opened on Wednesday, July 8, for regular courses of seven weeks in zoölogy, botany, and microscopical technique. The number admitted to this department will be limited to thirty, and preference will be given to teachers and others already qualified. By permission of the director, students may begin their individual work as early as June 15 without extra charge, but the regular courses of instruction will not begin before July 8.

More advanced students who may wish to limit their work to special groups will have an opportunity to do so. The regular course in zoölogy, under charge of Professor Bumpus, will embrace a study of the more typical marine forms and elementary methods of microscopical technique. The laboratory work will be accompanied by lectures. The following is an outline of the course proposed: July 8–13, study of the lobster; July 13–20, (*a*) study of annelids (*Nereis, Serpula, Spirobis*, etc.), (*b*) *Balanoglossus* and *Phascolosoma*, (*c*) *Polyzoa*, (*d*) *Turbellaria;* July 20–27, study of the cœlenterates; July 27–Aug. 3, study of the mollusks (*Mya, Ostrea, Sycotypus, Loligo*); Aug. 3–10, echinoderms (starfish, sea-urchin, holothurian, etc.); Aug. 10–17, crustaceans (*Branchipus, Cyclops, Lernœa, Lepas, Idotea, Orchestia, Cancer*); Aug. 17–26, vertebrates (*Amphioxus*, elasmobranch, teleost).

Arrangements for instruction in botany have not yet been completed, but it is hoped that Mr. Setchell will again be able to take charge of the work in this department.

Applicants should state whether they can supply themselves with microscopes and microtomes. Microscope slides, dissecting and drawing instruments, bottles, and other supplies, to be finally taken from the laboratory, are sold at cost. The tuition fee is twenty-five dollars, payable in advance.

Further information, if desired, may be had by addressing Professor Hermon C. Bumpus, Wood's Holl, Mass.

Applications for places in either department should be addressed to Miss A. D. Phillips, secretary, 23 Marlborough Street, Boston.

Rooms accommodating two persons may be obtained near the laboratory at prices varying from two to four dollars a week, and board from four and a half to six dollars. By special arrangement, board will be supplied to members at The Homestead at five dollars a week.

A department of laboratory supply has been established in order to facilitate the work of teachers and others who desire to obtain materials for study or for classes. It is proposed to furnish, e.g., certain sponges, hydroids, starfishes, sea-urchins, marine worms, crustaceans, mollusks, and vertebrates, in good condition, at fair prices. Orders for the coming college year should be given as soon as possible. Circulars giving information, prices, etc., may be obtained by addressing the Department of Laboratory Supply, in care of the secretary.

Wood's Holl, owing to the richness of the marine life in the neighboring waters, offers exceptional advantages. It is situated on the north shore of Vineyard Sound, at the entrance to Buzzard's Bay, and may be reached by the Old Colony Railroad (two hours and a half from Boston), or by rail and boat from Providence, Fall River, or New Bedford. Persons coming by the way of Boston should buy round-trip tickets ($2.85).

The Marine Biological Laboratory is intended to continue and extend the work of the laboratory at Annisquam, carried on for six years by the Woman's Education Association, with the cooperation of the Boston Society of Natural History. The annual reports of the trustees, containing an account of its organization and work, may be obtained from the secretary.

EXPLORATION OF THE BLACK SEA.

WE learn from the *Proceedings of the Royal Geographical Society* for March that Professor Woeikof, at a recent meeting of the Society of Friends of Science of Moscow, communicated some results of the scientific exploration of the Black Sea in the Russian gunboat "Tchernomoretz" in June and July, 1890. The mean depth in the basin is 6,000 feet. The minimum depth (below 600 feet) was found in the north-west region, bounded by a line passing from Varna, in Bulgaria, to Eupatoria, on the west coast of the Crimea; and the maximum depth (7,365 feet), in the central part, between the Crimea and Anatolia. The surface temperature varies from 72° F. in the centre of the basin, to from 75° to 77° on the west and east. At a depth of from 29½ feet to 174 feet, the temperature was only 57° towards the south coast, 54° in the centre, and 52° in the north and near the west and east shores. The variation of temperature in the Black Sea is very characteristic at depths exceeding 180 feet. At this point the thermometer marks only 45°; but then the temperature begins to rise, and at a depth of 6,000 feet it is 49°. In other seas, in mean latitudes, the temperature diminishes regularly from the surface to the bottom, or rather below a certain depth it remains invariable (56° for the Mediterranean).

Another peculiarity of the Black Sea is, that at a depth of 450 feet, traces of sulphuretted hydrogen are found, the proportion of which increases so rapidly that it becomes quite sensible at 600 feet; and at 940 feet, and under, it renders animal life entirely impossible. At that depth were found only the semi-fossil shells of certain mollusks characteristic of the brackish water of the lagoons of the Black Sea and of the Caspian. They are the remains of the Pontic fauna which inhabited the Black Sea at the pliocene epoch, when this basin, still separated from the Mediterranean, and with a depth of only 3,000 feet, contained water of but feeble salinity. At the opening of the Bosporus, the waters of the Mediterranean would make their way into the Black Sea, and lead to the disappearance of the ancient fauna. The sulphuretted hydrogen, then, is only one of the products of the decomposition of these ancient organisms, the elimination of which takes place very slowly, owing to an immobility almost absolute of the water at a certain depth.

The Black Sea receives annually, by way of the Bosporus, only a thousandth part of the total volume of water in the basin, and consequently it will take a thousand years to completely renew the whole contents of the basin. It is thus easy to understand the slowness with which the deep waters participate in the circulation of the liquid mass.

THE VEGETABLE FIBRES OF TRINIDAD.

THE United States consul in Trinidad has recently forwarded to the government a report upon the vegetable fibres of that island, and gives a description of some of the most important of them.

The *maholtine* is a plant which grows wild in large quantities. It is easily cultivated by simply cutting down bushes and burning them, and scattering the seeds of the plant. One acre of good ground will produce about five thousand pounds of stalk; and this stalk, reduced to fibre, will make about eight hundred pounds. The stalk grows from eight to twelve feet, the skin or bark of which is stripped off, and steeped in cold water, eight or ten days after which the green watery substance is washed out, leaving a fibre eight to ten feet long.

The white *mahoe* (*Sterculia caribœa*), like the *maholtine*, grows wild, and may be cultivated in the same way, producing the same quality of fibre. The fibre is whiter and more silky than that of the *maholtine*, and is believed to be superior to it, although it has never been sent abroad to test its merits. A crop is reaped every seven months.

The *gumbo*, or *okra* (*Abelmoschus esculentus*), is another stalk fibre, the plant growing six to eight feet high, and producing a fibre about the same length. Cultivated on good soil, it will produce four thousand pounds of stalks, yielding as much fibre to the pound as the *maholtine* or the white *mahoe*.

The fibre of the *gumbo*, unlike those above mentioned, will not contain water, but throws it off like oil silk. A crop is harvested every seven months.

The plantain (*Musa sapientum*) will produce from five to six pounds of fibre to each stalk. The stalks grow from eight to nine feet high, and eight hundred of them may be produced on an acre of ground. The fibre is obtained by putting on two wooden rollers, and rolling and squeezing the stalks to crush the watery pores, then steeping it in water eight to ten days, and finally putting it under the same rolling process with heavier weights.

The banana (*Musa paradisiaca*) grows four to five feet high, produces two to three pounds of fibre to the stalk, and eight hundred stalks to the acre, and the crop is annual.

Ramie, or China-grass, grows very thickly, and, when once planted, sustains itself against other grass. After the first year, it can be cut every six months. The stalk grows about four feet high. It will produce an ounce of fibre to every square foot. The plant was imported into Trinidad from China for experimental purposes about three years ago, and has not yet assumed any commercial importance.

The *mahoe bord du mer* (*Paritium tiliaceum*) does not grow inland, but on the seashore. It is a stalk fibre, but, unlike the above, it branches, and the branches also produce fibre. It grows eight to fifteen feet high. Each tree will produce about half a pound of fibre, and one acre can support eight hundred trees.

Red *mahoe* (*Sterculia caribœa*) grows wild on any soil of the island, produces about eight hundred trees to the acre, grows eight to ten feet high, and then branches. The stalk and branches are both used for fibre, which is used by the natives for making rope. The crop is annual.

Rucon, or annotto, an Indian plant from South America, is a very strong fibre. One acre will support eight hundred stalks cultivated on fertile soil, and each stalk will produce about half a pound of fibre.

Black sage (*Cordia cylendros*) is a small shrub about six feet high, and produces a very strong fibre, used by the natives for making ropes. An acre of ground will support sixteen hundred plants, and they will give one-fourth of a pound of fibre to each plant.

Bois sang, or blood-wood, grows twenty-five feet high, and branches out eight to ten feet from the bottom. When tapped, the tree emits a fluid resembling blood, which produces a red stain. Both stem and branches produce fibre. About six hundred trees may be produced to the acre, and each tree will produce two to three pounds of fibre, which is used for rope-making. The fibre varies from four to six feet in length, is very tough, and would, it is said, make a superior twine for bagging. It is cut and planted every three years.

Balizier (*Hilicomea*) is a wild plant, grows on cool soil, and its presence indicates superior land. The blades, which resemble the blades of the plantain, produce the fibre; but the blades grow from the roots of the bush like a pine-apple, and they are six to ten feet long. One acre will produce about ten thousand blades, and each blade will produce half an ounce of fibre. It is a coarse fibre, not so strong as the others mentioned, but is useful for door-mats and similar purposes.

Cacao (*Theobroma*) is cultivated for its valuable fruit; but the tree, which grows fifteen or twenty feet high, is trimmed annually in the spring of the year, and the branches of each tree thus trimmed will produce half a pound of fibre, which varies from three to five feet in length. It is strong, and is used as rope for making hammocks.

Bois l'orme (*Guazuma ulmifolia*) is a straight tree. At a distance of eight or ten feet up the body of the tree, five or six branches shoot out in a circle round it; and, from this point to the top of the tree, encircling branches shoot out at the distance of about one foot apart. The lowest circle of branches are the longest, and they shorten as they ascend the tree, causing the tree to assume the shape of a sugar-loaf. Both the body and branches produce fibre. It is a straight brown fibre, and very strong, used generally for rope and twine making. Eight hundred trees may be produced to the acre, and, after the third year, will produce annually from one to two pounds of fibre to the tree.

The *Agave Mexicana* grows three or four feet high, and one

acre will support twenty-five hundred plants. After three years, each blade will produce half an ounce, or about half a pound to the plant. The crop may be reaped each succeeding year for from twelve to sixteen years without replanting. The plant becomes dry and worthless as soon as it produces a flower; but it rarely produces the flower before twelve years, and usually not before sixteen or twenty years. The plant grows wild on the island, but it is understood to have originally been brought from Mexico. The fibre is three to four feet long, fine, strong, and, it is said, would doubtless be good for textile purposes.

The *Agave Americana*, or American aloe, grows higher than the *Agave Mexicana*. It varies in height from four to five feet, and the fibre is the same length. It grows abundantly, chiefly near the seashore, and is understood to be a native of the island. The fibre is coarser than the Mexican agave, but about the same quantity can be produced to the acre.

Of the pine-apple (*Ananassa sativa*), only the blade, which is about two feet long, produces fibre. The fibre is strong and fine, and is believed to be well-suited for textile manufactures. It is of finer texture than either the American or Mexican agave.

Agave rigida, or sisal hemp, has lately been introduced into Trinidad. The blades alone, which grow about two and a half to three feet long, are used for fibre. Eight blades, it is said, give an ounce and a half of fibre, and the fibre obtained is about three feet long, strong, coarse, and stiff, suitable, it is believed, for strong ropes and chair-bottoms. An acre will support two thousand plants of about sixteen blades each, and calculated to produce at each reaping three ounces of fibre to the plant. After three years a crop is reaped annually.

Among the fibre-producing plants of Trinidad may be mentioned the *gemove* (*Malachra*); *bois ceip* (*Oreodaphne cernua*); *Gumbo mizse*, the pinquine or wild pine apple; the Spanish needle (*Yucca*); and the *Sanseviera zeylanica*.

Consul Peirce states, in conclusion, that he has been informed that there is no machine now in use in the colony which obtains the fibre without destroying the substance of the fibre-ribs. The principal machine, if not the only one, now used in Trinidad and Tobago, is arranged for the operator to hold the blade of the plant in his hand, while the machine scrapes out the green and watery substance. The opinion has been expressed that if a machine could be introduced that would act somewhat on the principle of a cane-mill, in which the cane enters one side and comes out at the other thoroughly crushed and squeezed, a great advantage would be gained over the present practice.

BETTER COWS FOR THE DAIRY.[1]

THE need of better cows for the dairy is coming to be very generally appreciated. The dairy commissioner of Iowa is reported as saying that the average cow in that State gives but 3,000 pounds of milk annually, while good ones yield from 5,000 to 6,000 pounds. The director of the Vermont Station states that the average yield per cow in that State is only about 130 pounds of butter per annum, while there are thirty dairies in the State that average over 300 pounds per cow.

The director of the New York Station says, "New York has 1,500,000 milch cows, probably producing, on an average, less than 3,000 pounds of milk per year, and the annual average butter-product per cow for the State is undoubtedly less than 130 pounds. This should not be, when there are whole herds averaging 300, and some 400, pounds of butter per year for each cow. Animals producing these by no means phenomenal yields are not confined to any particular breed, and are often grades of our so-called native or no-breed animals. Proper selection, systematic breeding, and judicious feeding have produced these profitable animals and herds."

The difference in the milk-producing qualities of different cows is brought out very clearly by a series of experiments conducted at the Massachusetts State Station, of which Professor C. A. Goessmann is director. They are especially interesting, because the cows and their feed and care were such as are found on the better farms of Massachusetts; and the results, obtained with the appliances of a well-equipped experiment station, show in accurate and full detail the elements of actual profit and loss as they could not be found in ordinary farm experience.

These experiments have been made with twelve cows, and have continued over five years. Grade Jersey, Ayrshire, Devon, Durham and Dutch, and native cows were used. They were secured for the experiments a few days after calving, and fed until the daily yield fell below 5 or 6 quarts, when they were sold to the butcher. The length of the feeding-period, i.e., duration of the experiment with each cow, varied from 261 to 599 days. Hay, fodder, corn, corn-silage, green crops, roots, and corn-meal, wheat bran, and other grain, were used. The daily ration per head consisted of 18 to 20 pounds of dry fodder, or its equivalent of green fodder, and from 6½ to 9¾ pounds of grain. Careful accounts have been kept of the history of each cow, including breed, age, number of calves, length of feeding-period, amounts and kinds of fodder, yield of milk, chemical composition of feed, milk, and manure, cost of cow and feed, and values of milk and manure.

The following is a recapitulation of the financial record of the cows. The milk was reckoned at the price paid for it at the neighboring creameries. The value of the manure produced is calculated by assuming, that, of the total amount of food, 20 per cent would be sold with the milk, and the remaining 80 per cent saved as manure. As farmers in the region buy commercial fertilizers for the sake of their nitrogen, phosphoric acid, and potash, it was assumed that these same ingredients would be worth about as much, pound for pound, in the manure as in the better class of fertilizers, and accordingly the value of the manure was computed by taking the nitrogen as worth 16½ cents, phosphoric acid 6 cents, and potash 4½ cents, per pound. The return for feed consumed represents what the feeder receives for labor, housing of cattle, interest of capital invested, risk of loss of animal, etc.

The most profitable cow was bought for $60, fed 584 days, and then sold for $28, making her actual cost $32, and the feed cost $135.05; so that the total cash outlay was $167.05. The milk brought $203.37 at the creamery, and the manure was estimated to be worth $56.93, making the total value received for feed consumed, $260.30. Subtracting the total cash outlay of $167.05 from this, there remains $93.25 as net return for feed consumed. Deducting the estimated value of the manure, the remainder, "return in excess of estimated value of manure," is $36.32. In the average for the twelve cows, the net return was $50.43; and the return in excess of the estimated value of the manure, only $15.13. With the least profitable cow, the cash outlay for cow and feed exceeded the value of the milk and manure by $3.97: in other words, the net return for feed consumed was $3.97 less than nothing. Subtracting the value of the manure, the total loss was $34.25; that is to say, allowing for the value of the manure, the results with the twelve cows varied from a gain of $93 to a loss of $3.97, or, if the value of the manure be left out of account, from a gain of $36.32 to a loss of $34.25.

It is noticeable that the profit or loss did not depend upon either the breed or the length of the feeding-period. The most profitable cow, and the least profitable but one, were both of the same breed. Of the two most profitable cows, one was fed for 584 days, and the other for only 278 days.

Two things, then, are brought out very clearly by these experiments. One is that in such localities as this, the value of the manure goes far to decide the profit in feeding dairy cattle. Another is that cows which would ordinarily pass for good ones may differ widely in product.

To the practical dairyman these experiments teach clearly the difference between cows which are profitable and those which are not, and the importance of selecting the best cows for his dairy and getting rid of the poor ones. In a larger sense, they illustrate to every farmer the importance of knowing accurately the condition of his business. Upon this its success or failure largely depends.

[1] From Farmers' Bulletin No. 2 of the United States Department of Agriculture.

HEALTH MATTERS.

Suicide among German Children.

A CURIOUS return has been made concerning some 289 instances of suicide by school-children in the German Empire during the six years 1883 to 1888 inclusive, as we learn from the *Lancet* of Jan. 31. The interest of the return centres in the motives assigned for these extraordinary acts. Among the cases which could be so explained, the largest proportion appear to have been attributable to fear of punishment. This, perhaps, might have been expected; nor is it altogether surprising that such extreme terror should be chiefly exhibited among pupils of the elementary schools. The fact that twenty per cent of all the collected cases fall into this particular class should, however, afford food for reflection. It is certain that undue severity has been practised, or at least undue apprehension has been aroused, in every one of these instances, seeing that the little victims were so far thrown off their balance by it as to be driven to the extremity of suicide. It would be unjust to assume that for these exaggerated fears the teachers are wholly or even mainly responsible; but, on the other hand, no really efficient teacher would ever leave upon a child's mind an impression so horrible as to precipitate such a crisis as this. The child who takes his own life rather than face an angry teacher must believe, rightly or wrongly, in the ferocity of the teacher; and it is much to be feared that children of tender years, even when they are not so terror-stricken as this, are apt to nurse a suspicion that most strangers and some friends, the teacher in particular among the latter, are human wolves. To eradicate this mischievous misapprehension ought to be one of the first tasks of a successful preceptor. Among the high-school pupils the suicides are almost exclusively boys, and here the most common motive is dread or disappointment in connection with examinations. Mental derangement and thwarted ambition come next in order, while precocious sentiment claims its share to the extent of four boys and one girl, whose unhappiness is recorded as due to *une affaire de cœur*. It is some satisfaction to be able to add that these emotional young people were all past the elementary school stage.

In the *British Medical Journal*, Oct. 11, 1890, the following additional data are given: —

Of the 289 cases of suicide among school-children in Prussia, 240 of them were boys, and 49 girls. The cases are apportioned among the different years as follows: in 1883 there were 58 suicides; in 1884, 41; in 1885, 40; in 1886, 44; in 1887, 50; and in 1888, 56. In 86, or 29.8 per cent, of the cases, the motive of the deed is unknown; but in 80 the causes were fear of punishment; in 19, disappointed ambition; in 16, fear of examination; and in 28, insanity and melancholia; 5 of the suicides are attributed to love: and 7 are believed to have been half unintentional.

The Action of Koch's Liquid on the Monkey.

The effects of Koch's liquid on a quadrumanous animal so vulnerable to the invasion of the bacillus as the monkey have been investigated recently by Hénocque at the Collège de France, says the *Lancet* of March 7. M. Hénocque states that when his monkey entered the laboratory (Dec. 21, 1890), auscultation yielded no physical signs denoting phthisis. Two days after the first injection a few râles and impaired resonance were noted at the right apex. The third injection determined dulness still more marked, and, in addition, slight dulness at the left apex. From this moment all the symptoms of acute phthisis manifested themselves (cough, anorexia, debility, intense fever); and eight days later the animal died, having lost a tenth of his weight. At the necropsy four tubercular masses of the size of a big pea were discovered in the right lung, the left organ in two-thirds of its extent being the seat of caseous pneumonia. Surrounding the lesions there were zones of red hepatization, with marked exudation of red blood-corpuscles. Two guinea-pigs have been inoculated with portions of the pneumonic tissue, and both animals now present signs of cutaneous and glandular infection. The total quantity of fluid received by the monkey was six milligrams, — a quantity apparently quite capable of determining the onset of acute phthisis.

NOTES AND NEWS.

THE facts derived from the study of soil-absorption at the Purdue University Agricultural Experiment Station, Lafayette, Ind., lead to the same conclusion as the results of the latest experiments on the use of fertilizers,—that, in a system of farming having in view large crops and permanent improvement of the land, phosphoric acid and potash should be used in considerably greater amounts than the crops required, while nitrogen compounds should be used in amounts not greatly in excess of the needs of the crop.

— Professor Ogata of Tokio reports a case of cholera occurring in a dog. The dog had been vomiting and purging for some time, according to the *Medical Record* of March 28, and was brought to Dr. Ogata's laboratory by a police-surgeon. After the death of the animal, several plate-cultures were made of the contents of the small intestine, from which comma bacilli were obtained in almost pure culture. Examination under the microscope, of a thin piece of the small intestine, which had been kept in alcohol and stained with gentian violet and alkaline methyl blue, showed the presence of the comma bacilli, not only on the surface of the mucous membrane, but also within Lieberkuhn's glands.

— The habits of *Brachytrypus*, the huge desert cricket of the Mediterranean region, have only recently been studied by A. Forel, although, excepting the mole crickets, it is the largest known European form. The reason appears, as we learn from *Psyche* for April, in the fact that it is a nocturnal insect, remaining in its burrows by day, and even closing the entrance to the same (although it is three or four centimetres in diameter) to an extent of several centimetres, leaving only a little sand-heap to mark its place. Dr. Forel discovered them by marking the spot where he saw and heard them chirping lustily in the dusk, and the next morning detected the heaps, carefully removing which, the burrows were found. These extended for over a metre in length, and half as much in depth; and digging the creature out was a thankless task. Dr. Forel obtained some by drowning them out, and others in a way characteristic of a myrmecologist. He secured a bag of ants, a species of *Acantholepis*, and, setting them loose before the burrow, they entered it, and soon ousted the occupant.

— In the *Lancet* of Feb. 14, Mr. J. A Wanklyn, in a note on aldepalmitic acid, says that it has long been known that the acids arising from the saponification of butter include small proportions of butyric, caproic, caprylic, and rutic acids. The larger proportion of the acids has, up to the present, been held to consist of palmitic, oleic, and stearic acids, which are non-volatile, and insoluble in water. In the course of investigations with which he has been engaged for a number of years, Mr. Wanklyn states that he has arrived at the very unexpected result that the main acid is not palmitic acid, but an acid quite distinct from palmitic acid, both in composition and properties. On the 19th of January he had the honor of reading a paper on the subject before the Society of Chemical Industry, and in due time the details will doubtless be published. In the mean time it may be of interest to mention that the new acid, which is so abundant as to amount to about half of the weight of the dry butter, differs from palmitic acid by containing less hydrogen, and that its formula is $(C_{16}H_{30}O_2)n$. The melting-point of the new acid is about 50° C., whereas palmitic acid melts at 62° C. The new acid possesses the extraordinary property of consolidating or gelatinizing alcohol. At temperatures below 5° C it gelatinizes more than five times its weight of alcohol. Part of the alcohol is held mechanically by a sponge-like action, and part is retained in chemical combination. Palmitic acid possesses no such property: indeed, no other substance does.

— The following is an abstract of a bulletin of the Ohio Experiment Station, now awaiting publication by the State printer. The oat-crop of Ohio for 1890 was one of the poorest on record: it was quite the poorest at the experiment station, owing to the attack of a peculiar disease which caused the blades to turn yellow when the oat-plants were about six inches high, and stunted their growth throughout the season. Only four out of the fifty-four differently named sorts tested by the station in 1890 yielded so much as thirty-three bushels per acre. Generally, five to eight pecks of

seed-oats have given a larger yield than a larger quantity; and drilling has been followed by better crops than broadcast seeding. An experiment in steeping seed-oats in hot water indicates that by this method the greater portion of the loss from the smut of oats may be prevented. The process, briefly stated, is as follows: have two vessels, in one of which water is kept warmed to about 120° F., and in the other to as nearly exactly 135° as possible. Have a basket of wire netting, or a loose splint basket covered with cloth. The water-baths must be large enough to admit this basket. Fill the basket with seed-grain, and immerse it in the cooler bath, keeping it there and stirring it around until all the grains are warmed; then lift it out and plunge it into the hot bath, where it should remain from eight to ten minutes, being stirred or agitated meanwhile. Then remove it and dip it into cold water, or spread the grain out and throw cold water over it, after which dry it sufficiently for sowing. The effectiveness of this method depends upon having the water hot enough to destroy the smut germs, which may be adhering to the outside of the grains of oats, but not so hot as to destroy the oat germ. The reason for using two vessels is, that if one vessel were used, the water would be cooled too much by the cold grain to accomplish the purpose in view, or, if it were heated hot enough to do this, it would be so hot as to destroy the vitality of much of the grain.

— The injury from hail in Würtemberg during the sixty years 1828–87 has been investigated by Herr Bühler. As stated in *Nature* of March 19, the yearly average of days with hail is 13; and about .92 per cent of the cultivated land was affected, damage being done to the extent of about $600,000. July had most hail (34 days); June coming next, with 30.1 days. There is no evidence of increase of hail in the course of decades. The Black Forest district seems to have specially suffered. The author makes out 17 paths of the hail-storms. One very often frequented is that on the Danube, from Scheer to Ulm (70 kilometres long and 15 broad). All the paths seem connected with the configuration of the ground, and limited in many cases by quite low heights. Slopes with a western exposure are more in danger than those with an eastern, and plains suffer much less than hilly ground. The frequently affirmed influence of forest on hail-fall is not distinctly proved by the Würtemberg data. Herr Hellmann has made a further study of the figures, and finds that in Würtemberg, as in the Rhone Department and in Carinthia, the chief maximum falls in the second half of July. A secondary one, nearly as high, occurs June 20–24. This holds also for Carinthia; while in the Rhone Department this maximum is earlier, in the first half of June.

— We have received from the Johns Hopkins Press a pamphlet containing "The History of University Education in Maryland," by Bernard C. Steiner, and an account of the origin and organization of the Johns Hopkins University, by President Gilman. Maryland has been very backward in providing for the higher education, whether general or professional, and Mr. Steiner, therefore, is unable to present so interesting a history as would be possible in some other States; but his account is straightforward and as minute as most readers will care for. President Gilman, after paying tribute to the memory of Mr. Hopkins, proceeds to explain more especially on what principles and with what objects in view the institution over which he presides was organized. He gives some account of the inauguration of the university, with extracts from the speeches made on that occasion by himself and by President Eliot of Harvard, and then briefly notes some of the main points in the university's history. The prominence of the graduate department is shown by the fact that from the first the graduate students have been nearly twice as numerous as the undergraduates, though in the last few years the undergraduates have increased the fastest.

— In answer to the query, "Do Americans love flowers?" the *Illustrated American* says that the fact of the matter is, we are not true lovers of flowers. We have imported the cult, and in time may pose as fairly faithful worshippers as we have succeeded in doing with respect to horses, dogs, and chickens. We overload our dinner-tables with roses, the florists make our ball-rooms reek with the stale smell of fading gardenias, our women decorate themselves with huge posies, and we pile wreaths upon the coffins of departed friends. This is the love of display, not the love of flowers. Look at the names our indigenous flowering plants bear. Nature has supplied us with a flora as rich as any in the world. But, with the exception of the golden-rod, we have not given our flowers names that have any pretence to being poetical,—names which show that we take any interest beyond a purely scientific one in the plants. That lovely yellow violet, with its outside petals tinted a reddish brown, which clusters on our Western foot-hills, is only known as the *Viola Nuttallii*. In countries where the wild-flowers are really appreciated, the folk would have found some more suggestive name, such as "forget-me-not," "daisy," or "our lady's slipper." To whom, outside of Boston, would *Anemone patens* suggest the large purple flowers that beautify the rugged Rockies, or that *Calochortus venustus* was the lovely plant with crocus-like flowers that whitens the plains? And yet these are the only names they bear.

— An interesting general statement of the characteristic features of the entomological, and especially coleopterological, fauna of the canton of Valais, comprising the upper valley of the Rhone, will be found in Professor Ed. Bugnion's "Introduction to Favre's Faune des Coléoptères du Valais," now publishing in quarto form in the memoirs of the Swiss Society of Natural Sciences (vol. xxxi). Mr. Bugnion, according to *Psyche*, divides the district into three regions or zones,—the lower, the sub-alpine or forest, and the alpine,—their highest levels respectively at 800, 2,000, and 2,700 metres. The sub-alpine he further subdivides into a lower forest, whose upper limit reaches 1,350 metres, and an upper forest region, the latter characterized by the prevalence of conifers and rhododendrons. These divisions, as he points out in a note, differ from those of preceding authors, though not very greatly from the latest authority. Heer in 1837, writing for the whole of Switzerland, made out seven zones, each 450 metres in height after the field (campestre) which terminated at 300 metres. The succeeding were the hill or colline, with an upper limit at 750, the mountain (1,200), sub-alpine (1,650), alpine (2,100), subnivale (2,550), and nivale (3,000). Rion in 1852 made four divisions as follows: 1. Zone of cultivation, 375–1,263 metres; 2. Zone of conifers, 1,263–2,050 metres; 3. Zone of alpine pasturage, 2,050–2,760 metres; 4. Zone of eternal snow, 2,769 metres upward. Christ in 1883 also made four divisions: 1. Lower zone up to 550 metres (700 in south Switzerland; 2. Zone of deciduous trees, 550 (or 700)–1,350 metres; 3. Zone of conifers, 1,350–2,100 metres (2,300 in central Alps); 4. Alpine zone, 2,100 (or 2,300)–3,000 metres (perpetual snow). Professor Bugnion gives a larger number of groups of specific forms, mostly *Coleoptera*, inhabiting two districts, or living under different conditions, etc., in illustration of their geographical distribution, and, after discussing at some length the geological antiquity of insects, endeavors to show from what sources the different elements of the entomological fauna of Valais were directly derived.

— The population of the city of Vienna, according to the *Journal of the Society of Arts*, London, is about 800,000, and, with the suburbs and neighborhood, over 1,000,000. The consumption of animal food in 1888 consisted of 77,512 cattle, 147,978 calves, 31,469 sheep, 37,105 head of lambs, kids, and sucking pigs, and 178,466 pigs; of meat, 189,171 metrical quintals; of game, 2,377 deer, 871 wild boars; chamois and other game, 10,221 head; hares, 201,221; pheasants, 27,048; partridges, 112,778; of poultry, 898,968 pairs of fowls and pigeons; 485,775 pairs of geese, ducks, turkeys, and capons; of fish and crayfish, 12,851 metrical quintals; of butter, oil, and fat, 35,848 metrical quintals; of eggs, 83,750,000; honey, 694 metrical quintals; rice, 13,210 metrical quintals; flour, 525,795 metrical quintals; bread, 176,437 metrical quintals; wheat, 36,288 metrical quintals; legumes, 75,102 metrical quintals; asparagus, 333 metrical quintals; cauliflowers, 4,198 metrical quintals; fruits, fresh, dried, or preserved, 256,523 metrical quintals; liqueurs, 62,500 hectolitres; wine, 361,300 hectolitres; beer, 1,039,000 hectolitres. There were also killed by the butchers for food, 6,277 horses. The price of meat per kilogram (2⅕ pounds) was, beef, 18 to 66 kreutzer; pork, 32 to 82 kreutzer; veal, 20 to 70 kreutzer; mutton, 20 to 60 kreutzer. The average number of fat cattle arriving weekly was 4,765 head.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

CHANGE OF FORM AFFECTING A MAGNETIC FIELD.[1]

HITHERTO the study of a magnetic field has been the study of the so-called lines of force radiating from the poles of magnets, either electro or permanent; and, so far as magnetism has been utilized in the arts, the changes in this external field have been brought about by the movements of an armature, having for its function to determine the direction and consequent density of the field. Such is the case in the instruments used in the telegraph, the telephone, in dynamos, and in motors. Sometimes conducting wires are so mounted in the field that their movement gives rise to electric currents, which signifies that the energy producing the tension in the field is absorbed in some measure by the moving wires, and is transformed into an electric current. In each of these cases the magnet producing the field is stationary; that is, changes in the magnetic field produced by it are due to a motion external to the magnet itself, and may be that of an armature, of a moving wire, or of its own bodily change of position,— a kind which is comparable with what is called external motion in thermo dynamics, to distinguish it from internal motions, or such as take place when the body changes its form. So far as I am aware, no study has been made of the effect of changing the form of a magnetic body on its field, or of the reaction upon itself of its magnetic condition due to a periodic change of form. Of course, it has been known for a long time that the form of the magnetic field depended upon the form of the magnet itself. For a straight bar magnet, this field is familiarly known by the arrangement of iron filings forming curved lines from each pole re-entering the opposite pole. When the iron is bent into a U-form, or horseshoe magnet, the field is mostly contracted to the space between the poles. These forms of magnets have been permanent ones for the purpose for which the magnet was made.

In the case of induction-coils, whether of one form or another, the magnetic change produced by it has been and is due to the electric change produced upon it by an electric circuit provided with intermittent or alternating currents.

Within a few years, attention has been called to the nature of the external field as being a part of what is now known as the magnetic circuit, which consists of these rings or closed circuits of lines of force, all originating in the iron part of the circuit, and for conducting which iron is by far the best. The poles of the magnet are simply the parts of the iron where the lines enter and leave, and they may be in any place. Usually they are at the ends of the iron, but not necessarily so. Whenever iron is placed in the magnetic field, these lines crowd into it, as it is a much better conductor than the ether. When the iron is made into a ring form and then magnetized, there is no external polarity, and consequently no external field, provided that the iron has sufficient conducting cross-section at every part.

The following experiments have been tried, to determine what effects, if any, are produced upon a magnetic field by changing the form of the magnet. It was thought at first, that if a helix was coiled into a circle and a current was present in it, changes in its form would produce corresponding changes in the magnetic field external to the coil, especially noticeable if a flexible iron ring was enclosed in the helix so as to condense the magnetic field. This was put to the test in the following manner.

I. A coil similar to the one described above, but containing a solid ring of iron about eight inches in diameter and an inch thick, had its coil put in circuit with a reflecting galvanometer of low resistance, and at such a distance from it that magnetic fields external to its circuit could not act upon it. Another coil made about a flexible ring of iron wire was put in circuit with a battery, so as to magnetize the ring strongly. Then, with one ring parallel to the other, the flexible one was made suddenly to assume an elliptical form. Each such change in form, from one ellipse to another at right angles to it, gave a deflection of the needle to the right or left, and uniformly for a given phase of change. It was also observed that the direction of the deflection was reversed when the flexible ring was turned the other side up.

II. The same flexible ring, used in the same way, but without the current through it, gave substantially the same results. Of course, the ring was permanently magnetized, and the change might have been inferred.

III. As the same kind of motion, due to change of form, is taking place when a ring is vibrating at its harmonic rate, producing what we call sound-vibrations, it was thought probable that a magnetized ring, having a coil of wire about it in connection with a telephone, would set up vibratory currents when it was struck; and this was found to be true, for, when the coil containing the heavy iron core was put in circuit with a telephone in another room, the sound of the stroke and the pitch of the ring could plainly be heard. In the first case, the number of turns of wire was small, perhaps fifty or thereabouts. I therefore had two larger rings made, each about one foot in diameter and half an inch thick.

IV. One of these was wound with six or seven hundred turns of No. 32 wire. Before it was magnetized, it was connected with the telephone, and tested for its magnetic condition by striking. The ring could plainly be heard, which showed that it had some degree of magnetism.

V. Then about two hundred turns of coarse wire were wound upon it, and a strong current sent through it to magnetize it. After this magnetizing coil had been removed, the ring was again tested as in IV. The sound was very much louder. Indeed, the telephone could be held a foot from the ear and be heard.

VI. With the ring in V. still in circuit, the companion ring, without any wire upon it, was brought near it and struck. The sound was easily heard in the telephone circuit.

VII. This second ring was now magnetized in the same way as the first, when the magnetizing helix was removed, and experiment VI. repeated. The sound was very much louder.

VIII. The ring was now struck and moved away from the first ring by stages of an inch or two at a time. It was found possible to hear its pitch in the second circuit, when it was a yard or more away from it.

IX As the pitch of the two rings was not quite the same, the higher one was loaded so as to bring them to unison. The sound was then louder and more persistent than before. This gave evidence that it was a case of sympathetic vibration, while the former were forced vibrations.

[1] Paper presented Jan. 14, 1891, by A. Emerson Dolbear, to the American Academy of Arts and Sciences, Boston.

X. A common horseshoe permanent magnet, with legs about six inches long, had perhaps fifty ohms of No. 32 wire wound about the bend, and this was put in circuit with the telephone, and struck like a tuning-fork. The sound in the telephone was very loud; indeed, too strong to be held comfortably at the ear.

XI. A coil of wire was now put about the middle of a piece of gas-pipe, which was without permanent magnetism. The piece of pipe was about four feet long and five eighths of an inch in diameter. This, when in connection with the telephone, was struck two or three times a second with a piece of brass rod, and while being thus struck it was rotated from the magnetic meridian to a position at right angles to it. The difference in the loudness of the sound, between the position in the meridian and away from it, was very marked. It is therefore shown to be possible to determine the points of the compass with a telephone, a coil, and an iron rod.

XII. A second flexible ring was now made, about a foot in diameter, consisting of a bundle of soft iron wire, the ends being roughly braided and twisted together. The thickness of this was rather less than half an inch. This was covered by a rubber tape wound spirally round it, the better to secure stability of form and insulation. Then 4 6 ohms of No. 21 wire were wound about it its entire length, making probably a thousand turns. It was then magnetized by a current from three secondary cells having six volts, giving a magnetizing current of about thirteen hundred ampère turns, leaving it a ring magnet. The terminals were then connected with the terminals of a reflecting galvanometer with a resistance of .67 of an ohm. Very slight changes in the form of the ring, either by pulling or pushing, gave decided movements to the needle, while larger amplitude gave thirty to forty degrees' deflection.

XIII. It was noticed, also, that the direction of the current depended not only upon the direction of the motion of changing the form, but also upon the direction of the motion with reference to the normal shape of the ring. Thus, if the ring be a circle, and it be drawn into a horizontal ellipse, the current will move the galvanometer-needle, say, to the right. When it is brought back to the circular form, the current is reversed. If the motion be continued so as to produce a vertical ellipse, the current will be in the same direction as that produced at first by a motion exactly opposite in direction; so that for a complete cycle of vibratory changes four currents are generated,— two direct, and two reverse.

XIV. One of the iron rings before mentioned, a heavy one about eight inches in diameter and an inch and a half thick, having coarse wire wound upon it nearly covering the ring, was connected with the galvanometer as before, and the ring was struck by a brass rod. The needle instantly swung through a wide angle. Struck again, it moved as before, but not through so wide an angle, and a half-dozen blows knocked nearly all the magnetism out of the ring. This was then detached from the galvanometer and magnetized, as before, when it again gave the same large deflection it gave at first. The same conditions were tried with other rings, and in each case it was found that a vigorous stroke upon the ring magnet had the same destroying effect upon the magnetism as it has upon magnets having external fields.

XV. The flexible ring was now put in circuit again, and vigorously jerked with the hands. A very few such movements served to destroy nearly all the magnetism present, requiring the remagnetization of the ring.

As flexible iron rings such as I wanted were not easy to make, I procured some steel wire rope of the right size, and the ends were welded for me through the courtesy of Professor Elihu Thompson of Lynn by his electrical welding process. Such a ring about a foot in diameter allows a movement of five or six inches to one of its sides. This, when wound with four or five hundred turns of No. 22 wire, may be magnetically saturated by sending a current through the wire, leaving the ring charged. The terminals may now be connected with a proper galvanometer, and changes in the form will discharge the ring.

These experiments prove, —

1. That a change in the form of a magnet causes corresponding change of stress in the field.

2. That periodic changes in form due to elasticity of form, such as are called sound-vibrations, set up similar periodic changes or waves in the magnetic field.

3. That such sound-vibrations of a magnet act upon other magnets like sound-vibrations, and set them into corresponding vibratory movements, sympathetic or forced, — sympathetic when the receiving magnet has the same pitch as the transmitting magnet, and forced when it has not the same pitch.

4. That such sound-vibrations in the receiving-magnet cause a corresponding change of form in its magnetic field, which manifests itself by electric currents in circuits surrounding it.

Sir William Thomson has frequently said that he could understand a mechanical idea when he could make a model of it, but could not otherwise. If one assumes that the ultimate atoms of iron are magnets, as is thought most probable now, or holds, by Ampère's hypothesis, that currents of electricity circulate about each atom, making it a magnet — in either case, each individual atom has its own magnetic field, which is necessarily always with it. It is really its re-action upon the ether. If such atoms be elastic, as there is the best of reasons for believing, then it follows that impact must set them into periodic vibratory motion; that is, periodic change of form at a rate depending upon its degree of density and elasticity. Such changes of form set up corresponding periodic waves in the ether, as changes in the magnetic field; and these are transmitted outwards with a rate depending upon the properties of the ether to transmit such motions, not upon the source of the disturbance.

Such vibratory motions among atoms and molecules we call heat, and such periodic waves in the ether we call light, and thus Maxwell's idea of light being an electro magnetic phenomenon is altogether in accordance with the experiments. For waves of the lengths of light waves, it is essential that the vibrating body be small and highly elastic. Maxwell's idea was, that the opposite phases of ether-waves could produce opposite electrical effects, so that each half-vibration represented either positive or negative conditions; and these implied, though I have not noticed the statement, that they must have originated with vibrating magnetic atoms or molecules. It has been difficult or impossible heretofore to imagine how ether-waves could be set up by vibrations of the elements, though the idea that the atoms of matter are magnets is not new at all, and has a good degree of probability.

If one is to picture to himself at all how this kind of a phenomenon can occur, he is bound to have in mind some form for an atom that shall at the same time be a consistent magnetic form. If atoms are magnets, it is well-nigh inconceivable that they should be spheres or cubes, or tetrahedra, or disks, or any of the ordinary geometric forms, for such would be very poor forms to exhibit magnetic properties. But a ring presents a very different case, as a ring magnet is the most perfect form possible. There is this to be said of such a form, however. It does not present what we commonly call a magnetic field: it is a closed circuit.

Nevertheless, I would ask if it is probable that the ether external to a magnet of that form should be quite unaffected, quite neutral. I should suppose not, but, on the contrary, should look for some sort of stress there, though it might be of somewhat different nature, and have somewhat different properties, from an ordinary magnetic field. But if such were the case, it follows that any magnetic change in the ring magnet itself would be followed by a corresponding change in the external field, and vibratory motions would necessarily set up waves in that field. Such waves would have a magnetic origin, but the waves themselves would not necessarily give rise to electro-magnetic effects directly. Indirectly they would; for, if they could make another similar magnet vibrate sympathetically, these vibrations would re-act upon its magnetic properties.

Such a ring form as I have shown suggests at once the vortex ring theory of atoms, of the properties of which I have so often spoken to the academy. Perhaps the experiments should have a different interpretation from that suggested here; but, whatever their interpretation may be, they are believed to be entirely new, and therefore of interest, if not important.

LETTERS TO THE EDITOR.

**** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

The Audubon Monument.

AUDUBON, the great naturalist, to whom this country is as much indebted as the English people are to White of Selborne for the accurate study of natural history, died in New York in 1851, and was buried in Trinity Cemetery. His family vault was in that part of the cemetery which, subsequent to the selection of the site, became 153d Street, which the city authorities have ordered to be opened. As there was danger of the vault being interfered with by the improvements consequent on the opening of the street, the trustees of the cemetery gave the family a new plot, and built a new vault at their own expense, to which his remains were removed in 1890; but no monument marks or ever has marked his grave.

In the year 1887 the New York Academy of Sciences appointed a committee, of which I was chairman, to collect funds to erect a suitable monument over his grave. Since that time the committee have labored constantly and earnestly to collect sufficient money to erect this monument, but with no very great success. A few generous responses have been received, and a number of conditional subscriptions have been made; but, counting them all together, less than half the amount necessary for the erection of the monument, the design for which was accepted by the committee, has been raised. If every appeal which has been sent out had been responded to by the contribution of five dollars, there would have been enough to erect both a monument over his grave and one in the park beside. It still remains a fact that the grave of the greatest naturalist that this city has ever produced, of whose work Cuvier said that it was "the most magnificent monument that art had ever raised to ornithology," is not distinguished by any mark of any kind, and that the committee, after four years of unremitting labor, during which they have tried every expedient known to them to induce people to subscribe, have failed to raise the amount of money which they consider necessary for a suitable monument. The committee are well aware of how many claims there are, both for the living and the dead; but this one has certainly not met with the response which it ought to have met with. The committee do not feel that they can carry on the work of collecting, which demands so much personal labor from them, over another year, and appeal earnestly to the public to support them, so that they may finish their labors during the year 1891, and erect over the remains of this great citizen of New York a monument worthy of his genius and his fame.

THOS. EGLESTON.

New York, March 21.

The very Peculiar Tortoise, Carettochelys Ramsay, from New Guinea.

THROUGH the great kindness of Professor Ramsay, curator of the Australian Museum, Sydney, I have just received some photographs of the unique specimen of *Carettochelys*. From these I reach the conclusion that *Carettochelys* is an ancestral form of the *Trionychia*.

One of the photographs shows the upper and lower view of the posterior portion of the skull. The most pecular character of this part is the enormously developed supra-occipital spine, which is spoon-shaped. The squamosals have also developed, exactly as in the *Trionychia*, large crest-like posterior processes. They do not reach so far behind as the supra-occipital spine. The whole shape of this portion of the skull is only comparable with that of the *Trionychia*. The pterygoids extend between quadrate and basiphenoid exactly as in this group. The quadrate is not entirely closed behind, as in the *Trionychia*, but only on the outside, leaving a posterior foramen, as in the *Podocnemididæ*, for instance. The articular face of the quadrate is as in the *Trionychia*, and so is the posterior end of the lower jaw. The shape of the pterygoids is also as in the *Trionychia*, but from the photograph I cannot ascertain whether they are curved up in front, as in the *Pleurodira*, or not. There is no parieto-squamosal arch, but a post-orbital and quadrato-jugal arch is present, resembling the arrangement in the *Trionychia*. The inter-orbital space is very large, and the orbits are lateral, much as in the *Staurotypidæ* and *Cinosternidæ*. The bones of the head are sculptured exactly in the same way as the shell, a condition only found in the Jurassic *Compsemys plicatulus* Cope. The nose was projected in front. It would seem from the photographs that there was a distinct very small mesoplastral bone.

Unfortunately the cervicals of the unique specimens have not been preserved by the collector. The condition of the pelvis, and the number of the phalanges in the fourth digit, are not yet known. To judge from the photograph, the latter do not exceed three. But I think it already possible to draw conclusions about the relations of this peculiar form. I consider it an ancestral form of the *Trionychia*, which still preserves the peripheral bones, and which has the carapace and plastron completely closed. Further finds will show whether the cervicals are already of the Trionychian structure, or whether they show the condition of the *Amphichelydia* or *Pleurodira*. There are only ten peripherals on each side, as in the *Staurotypidæ*, *Cinosternidæ*, and the fossil *Anostira* and *Pseudotrionyx;* and I should not be surprised to hear that this form will prove to be very close to *Pseudotrionyx*. I also believe that the group containing the *Dermatemydidæ*, *Chelydridæ*, *Staurotypidæ*, and *Cinosternidæ* is related to the ancestral *Trionychia*.

Carettochelys cannot be placed in any group of living tortoises: it has to be considered as the representative of a peculiar group ancestral to the *Trionychia*, and in relation probably to the *Amphichelydia*. This group I propose to call *Carettochelydes*. I can only hope that other specimens of this ancestral tortoise may be collected soon. The only specimen now in existence has been caught in the Fly River, New Guinea, and is now in the Australian Museum, Sydney.

G. BAUR.

Clark University, Worcester, Mass., March 26.

American Box-Tortoises.

THROUGH the kindness of Mr. Gustave Kohn of New Orleans, La., I have received lately a specimen of the Southern box-tortoise, made known for the first time by L. Agassiz under the name of *Cistudo major*, which name has to be changed into *Terrapene major*.

As is well known, one of the generic characters of *Terrapene* (*Cistudo*) consists in the absence of the bony temporal arch. Three years ago I showed that in the common Eastern box-tortoise (*Terrapene carolina L.*) a rudimentary quadrato-jugal is present, connected with the quadrate, but not reaching the jugal (*Zool. Anz.*, No. 296, 1888). I was greatly surprised to find now that the *Terrapene major* Ag. has the bony temporal arch well developed, exactly as in *Clemmys* or *Cyclemys*, for instance. This condition was seen in all specimens (three) examined. The Southern box-tortoise, therefore, appears as the most primitive form of the American species. This is also shown by other characters. The scapula is more primitive, the digits are strongly webbed, and the cervicals are longer. The *Terrapene ornata* Ag., only found in the Central States, is the most specialized form. There is no trace of a quadrato-jugal. The post-orbital arch has become very slender, the two branches of the scapula are of the same length, the cervicals are very short, and there are only two phalanges in the digits of the fore-limb. *Terrapene carolina* L. is between the Southern and Central form. All these species have one or two distinct ossifications at the upper end of the scapula.

I give now the characters of the three species: —

Terrapene major Ag. — Quadrato-jugal well developed, touching jugal and quadrate; cervicals long; upper branch of scapula considerably longer than inner branch (endo-scapula); digits with greatly developed webs; number of phalanges of fore-limb, 2, 3, 3, 3, 2; shell elongated.

Terrapene carolina L. — Quadrato-jugal rudimentary, only connected with quadrate; cervicals shorter than in *T. major;* upper

branch of scapula somewhat longer than inner branch (endo-scapula), but not so long as in *T. major;* digits not so much webbed as in *T. major;* number of phalanges of fore-limb, 2, 3, 3, 3, 2; shell not so elongated.

Terrapene ornata L.— Quadrato-jugal absent; cervicals very short; upper branch of scapula of the same length as inner branch (endo-scapula); digits without distinct web; number of phalanges of fore-limb, 2, 2, 2, 2, 2; shell rounded.

I have had no opportunity yet to examine fully *Terrapene cinosternoides* Gray (*triunguis* Ag.) and *Terrapene mexicana* Gray. *T. cinosternoides* is near *T. ornata.* It may perhaps show a rudimentary quadrato-jugal and a slight reduction in the number of the phalanges. I have only seen the two stuffed types of *Terrapene mexicana* Gray in the British Museum. They also resembled *T. ornata.* It would be very interesting to study the osteology of these forms. Besides, it is important to examine specimens from the intermediate localities, like Florida and South Carolina, to see how these forms agree with *T. major* and *T. carolina.*

I should be very much obliged to anybody who would send me specimens from different States of the country.

Terrapene is one of the plastic genera, and the examination of a great number of specimens from different localities doubtless will show some interesting results. G. BAUR.

Cla k Universty, Worcester, Mass., March 27.

BOOK-REVIEWS.

The Theory of Light. By THOMAS PRESTON. London and New York, Macmillan. 8°. $3.25.

EVERY one who has attempted to look up the literature of any scientific subject knows how laborious is the search through endless volumes of the Transactions and Proceedings of learned societies and of scientific periodicals. With some branches of science it may be impossible to make a book occasionally that shall give the existing state of the science; but with physical science this is from time to time attempted, and it was the object which Professor Preston had in view in producing his "Theory of Light"

It was his hope, and we think it has been realized, to furnish an accurate and connected account of the most important optical researches, from the earliest times up to the most recent date. Complicated mathematical theories have been avoided; yet the mathematical theory, which is so essential, has, in an elementary form, as well as the experiments on which it is founded, been given in sufficient detail to enable the student who has the necessary knowledge of the higher mathematics to take up with profit the original papers recently elaborated by various English and foreign writers.

All physicists are acquainted with the important researches, carried out in the last few years by Professor Hertz, which have proved experimentally the long-suspected close connection between light and electricity, and many will be glad to find in this volume a concise account of the results of these researches.

Outlines of General Chemistry. By WILHELM OSTWALD. Tr. by James Walker, Ph.D. London and New York, Macmillan. 8°. $3.50.

PROFESSOR OSTWALD is professor of chemistry in the University of Leipzig; and the translator of this work, Dr. Walker, is assistant in the chemical department of the university of Edinburgh. The author undertook to write a book which would meet the requirements of the student who, while not intending to devote himself to the detailed study of general chemistry, still wishes to follow intelligently the progress recently made in this important branch of science. The progress to which the author refers might be said to be that in the physics of chemistry.

The book is divided into two parts, — the first, on the chemical laws of mass; and the second, on the chemical laws of energy. In the first part we are told of what we know about mass, of the properties of gases, of the properties of liquids, of solutions, of the properties of solids, and of the theory of chemical compounds. It will be seen that nearly all these are subjects which are on the border-line between physics and chemistry; for instance, in the chapter on the properties of liquids, the author treats of their general properties, of the relations between the gaseous and liquid states, of boiling-points, of volume relations of liquids, of refraction in liquids, of rotation of the plane of polarization, of surface tension, of internal friction, and of the specific heat of liquids. In the second part, under the general heading of "The Chemical Laws of Energy," the subjects treated are, thermo-chemistry, photo-chemistry, electro-chemistry, chemical dynamics, and chemical affinity.

The amount of progress that has been made of late years in these physico-chemical researches is considerable, and we are fortunate in having the results brought together and summarized in so good a book. The author is to be commended for having avoided one error which many a writer is induced to make. Few chemists have had much mathematical training, so that they would find it difficult or impossible to follow the mathematical discussion of physical problems. In such cases Professor Ostwald has not sought to introduce a laborious proof based on elementary mathematics, but has chosen to give simply the result.

Die Kosmologie der Babylonier. By P. JENSEN. Straasburg, 1890.

Die Fluthsagen. By RICHARD ANDREE. Braunschweig, 1891.

THE study of comparative mythology is constantly teaching us how wide spread over the earth's surface are the same infantile explanations of natural phenomena. As soon as a tribe reaches a certain stage of intellectual culture, — and that by no means a high one, — it is sure to frame some theory, under the guise of a narrative or story, to account for the existence of the world about it.

One of the most ancient, and for that reason most interesting, of these stories of creation, is that of the Babylonians, of which we have a new and very accurate rendering by Jensen. It is a part of his general work on the cosmology of the Babylonians, the whole of which is characterized by great learning and acuteness. He refutes satisfactorily the opinion of those who have maintained that the creation legend of Babylon was derived from the "Sumerian" column of the inscriptions, though their opinion would have amounted to little if Halévy's suggestion is correct, that the Sumerian script is merely an esoteric alphabet of the general Semitic language of the country.

Jensen's comparison of the Babylonian creation myth with that contained in the first part of the Book of Genesis illustrates with additional force how closely the biblical text follows the older and more detailed Euphrates myth. "In both narratives (Babylonian and biblical) the sequence of events is absolutely the same. A greater similarity would deserve the name of a translation. The Bible has taken up the Babylonian creation legends, suppressing what was specifically Babylonian, and transforming what was mythologic and polytheistic into a monotheistic form" (p. 306).

In the Babylonian legend the Creator appears as *Marduk,* who is probably a personification of the morning sun (the light-bringer), who rises over the boundless ocean (*tiamat*), conquers the chaos of night, and separates the heavens above from the earth beneath.

Jensen also supplies a more accurate translation of the Babylonian flood-myth, correcting a number of errors in Professor Haupt's rendering, and adding valuable suggestions concerning the original text. Thus, the hero of the myth, referred to by Haupt and others as *Samas-napistim* (the "Sun of Life"), is transliterated by Jensen *Sit-napistim* ("he whose life was saved"), a much more appropriate appellation. The biblical story of Noah and the Flood is, as is well known, merely a version of the Babylonian myth.

The origin, distribution, and affiliation of the flood myths all over the world are the topics discussed by the well-known ethnologist, Dr. Richard Andrée, in his "Fluthsagen." It is an interesting collection of material, but scarcely up to what we might expect from so widely read an authority. The portions on America are particularly weak. He depends for the Algonquin flood myth on Squier's inaccurate reproduction of the "Walum-Olum," evidently not knowing Brinton's elaborate reproduction and translation of that unique record. Nor does he refer to the

same author's analysis of the American flood myths in his "Myths of the New World."

We do not expect much from European writers when they deal with American subjects; but certainly Andrée should have turned to Jensen's work, rather than to Haupt's, for his version of the Babylonian myth.

Passing over these shortcomings in his authorities, the scheme of the volume is satisfactorily carried out. After narrating briefly the myths from the various continents, he shows that they have no one common origin, though many are borrowed from others, as the biblical is borrowed from the Babylonian. The natural events that prompted their invention are described at some length; but the psychological elements at the base of many of them are not adverted to. While his work is thus a useful contribution to the subject, it falls short in several important points of what it should be.

AMONG THE PUBLISHERS.

AMONG the contents of *Outing* for April, 1891, may be mentioned "Whaling among the Esquimaux," by H. L. Aldrich; "The Athletics of Ancient Greece," by Dr. Harold Williams; "Evolution in Yacht-Building," by Capt. M. Roosevelt Schuyler; and "Composite Photography," by W. I. Lincoln Adams.

— In *The Atlantic Monthly* for April, we note Mr. Lowell's "Noto: An Unexplored Corner of Japan," and Francis Parkman's second paper on "The Capture of Louisbourg by the New England Militia." One of the most important papers in the number is "Prehistoric Man on the Pacific Coast," by Professor George Frederick Wright of Oberlin, in which he gives us the results of his investigations on the subject of the Nampa Image. The Hon. S. G. W. Benjamin, for some years United States minister to Persia, has a timely consideration of "The Armenians and the Porte."

—"The Soldier's First Aid Handbook," by Capt. and Assistant Surgeon William D. Dietz, U.S.A., just published by John Wiley & Sons, consists in the main of a series of lectures delivered to members of the hospital corps and company bearers, and covers the ground indicated in existing army orders. No claim is made for originality, but the author has succeeded in presenting his subject in the form best adapted for his purpose, and in a manner calculated to make it useful to the medical officer in the preparation of his lectures to enlisted men. The work will also be of use to line officers, who, in command of detachments, may have to meet emergencies in the absence of the surgeon.

— Mr. Francis A. Shoup has published a work entitled "Mechanism and Personality," in which he endeavors to harmonize the latest biological theories with the metaphysics of Kant and Lotze. We cannot say, however, that the work is very successful, the author's ideas being too vague and confused, and his views on some points too uncertain. Thus he includes under the term "personality" not only the mind, but the body, and he repeatedly confounds the relation between the mind and its various states with that between the one and the many. Indeed, he expressly says that this conception of the mind is the keynote of his book, which is obviously a mistake. The relation between the mind and its states is that of substance and attribute, and not that of number. Other examples of confused and mistaken thought might easily be pointed out; yet the book contains some good points, and is much simpler in style than the majority of philosophical works. It is published by Ginn & Co.

— The February number (No. 49) of the Riverside Literature Series (published quarterly during the present school year at 15 cents a single number, by Houghton, Mifflin, & Co., Boston) contains Part I. of "Hans Andersen's Stories," newly translated. This book contains eleven stories, among which are "The Ugly Duckling," "The Princess on the Pea," "The Little Match-Girl," and "The Constant Tin Soldier." The publishers have felt that too little attention has been paid hitherto to the importance of bringing to children of the lowest-reader grades as good literature as has been supplied for the higher grades, and with this end in view they have this year issued the numbers of the Riverside Literature Series especially for the second-reader grade. To quote from the account of Andersen and his work in the preface of the translator, "It is this nice sympathy held by Andersen with the peculiar phase of childhood which makes his writings so eminently fit for the reading of children: in entering his world they do not pass out of their own, but enlarge it, for by the means of his art they are introduced to the larger art of imaginative literature."

— Messrs. Houghton, Mifflin, & Co. announce that they have recently published an entirely new Atlantic portrait of Mr. James Russell Lowell. This new portrait replaces one which, although a favorite for some years, is not now a good likeness of Mr. Lowell. The new portrait is from a photograph taken by Gutekunst in 1889, and is an almost full-face likeness of the poet, the head being slightly turned towards the left.

— In view of the approaching centennial of the founding of the Patent Office in Washington, James Shepard's article, "The United States Patent System," in the *New England Magazine* for April, will be of interest to many. Mr. Shepard's article sheds light upon many of the knotty points which make our patent laws such a mystery to inventors, and such a gold-mine to their legal advisers. The article urges with special strenuousness the crying necessity of extending the existing facilities of the Patent Office, and enlarging the staff of this much-overburdened department.

— Some years ago, while prosecuting investigations along scientific lines, which resulted in a number of publications in English and in German, Professor Gore of the Columbian University experienced in reading technical German those difficulties which usually come to students who have studied only literary German. In the absence of any adequate aid for acquiring proficiency in the former style, he decided to prepare a handbook for technical German, and during repeated residences in Germany he collected material. In the light of this experience, he has prepared a "German Science Reader," which will be issued next month by D. C. Heath & Co. This book will contain an introductory chapter on the peculiarities of construction of technical German, followed by a graded collection of short essays on all branches of science, with notes, and a vocabulary of scientific words.

— The April number of the *Quarterly Journal of Economics* will contain two articles on the application of the doctrine of economic rent to capital and labor as well as to land,— one by Professor J. B. Clark of Smith College, and the other by J. A. Hobson of London, — the two writers having come to similar results independently and simultaneously. Professor Adolph Wagner of Berlin contributes an important article on Marshall's "Principles of Economics," and Dr. William Cunningham reviews Gross's work on the "Gild Merchant." There will be an unusual number of shorter articles and communications, the regular bibliography, and a survey of the social and economic legislation of the several States in 1890, prepared by W. B. Shaw of Albany.

— Messrs. Macmillan & Co. will shortly be issuing Landor's "Imaginary Conversations," in six volumes, the first to be issued in April, and the remainder at intervals. It is hoped that the whole publication will be completed by December. The edition is by Mr. C. G. Crump, who edited the "Pericles and Aspasia" for the Temple Library Series. The text will be a reprint from the complete edition of Landor's works published in 1876, compared with previous editions, and a bibliography is added to each conversation showing the various forms in which it was originally published. There will be short explanatory notes. A limited edition on large paper will also be published.

— In *The Century* for April, in the California Series, Mr. Julius H. Pratt gives a description of the emigration to California by way of Panama in '49. The pictures are striking, having been drawn by Gilbert Gaul, after originals made from life by an artist in 1850. In this connection is a paper of historical value by the late Gen. J. C. Frémont on his own part in the "Conquest of California." Several briefer papers on the general subject accompany the more important contributions of the series. In this number *The Century's* Mountain-Climbing Series, appropriate to the summer season, is begun, with papers on two separate expeditions

to Mount St. Elias, one expedition being that of Lieut. Schwatka, and the other that of the National Geographic Society and the United States Geological Survey. "Fetishism in Congo Land" is by Mr. E. J. Glave, one of Stanley's pioneer officers. In Topics of the Time the following subjects are discussed: cheap money, the effect of Christian science and mind-cure on the regular practice, and country roads. There will be found in Open Letters a little article by L. Clarke Davis of the *Philadelphia Ledger* on Willard, the new English actor; and a popular review of recent experiments and discoveries of Pasteur, Koch, and others, written by Dr. Mary Putnam Jacobi of New York.

— P. Blakiston, Son, & Co., the medical publishers of Philadelphia, announce for early publication "A Handbook of Local Therapeutics," being a practical description of all those agents used in the local treatment of disease, such as ointments, plasters, powders, lotions, inhalations, suppositories, bougies, tampons, etc., and the proper methods of preparing and applying them. That the various uses of each remedy may be thoroughly set forth, the following gentlemen have assumed the authorship: Harrison Allen, M.D., emeritus professor of physiology in the University of Pennsylvania, laryngologist to the Rush Hospital for Consumption, late surgeon to the Philadelphia and St. Joseph's Hospitals; George C. Harlan, M.D., late professor of diseases of the eye in the Philadelphia Polyclinic and College for Graduates in Medicine, surgeon to the Wills Eye Hospital, and Eye and Ear Department of the Pennsylvania Hospital; Charles B. Penrose, M.D., surgeon to the German Hospital, instructor in clinical surgery, University of Pennsylvania; and Arthur van Harlingen, M.D., professor of diseases of the skin in the Philadelphia Polyclinic and College for Graduates in Medicine, late clinical lecturer on dermatology in Jefferson Medical College, dermatologist to the Howard Hospital. Each remedy will be taken up in alphabetical order, and, after a description of their pharmaceutical properties by Dr. George I. McKelway, will be considered with reference to the local treatment of the affections above outlined.

— In the April *Magazine of American History* the frontispiece is a copy of the painting of "Columbus at the Court of Ferdinand and Isabella." The leading article, "The Chesapeake and Lieut. Ludlow," by Robert Ludlow Fowler, brings to light some unpublished letters about the naval engagements of the war of 1812. A short sketch of the first meeting of Admiral Porter and Gen. Sherman, as described by the admiral, will attract many. The essay of Hon. William Wirt Henry, "A Defence of Capt. John Smith," takes the reader into the beginnings of Virginia Life. "A Bundle of Suggestive Relics," by Hon. Horatio King, presents a curious exhibit of partisanship in the olden time. "The Power to grant Patents for Inventions," by Levin H. Campbell, gives the proceedings of the framers of the Constitution in 1787, in that line. "President Lincoln and his English Visitors," is a paper containing some readable anecdotes. "The Fate of a Pennsylvania Coquette," penned more than half a century ago by Mrs. E. F. Ellet; "Two Immortal Letters" of Grant and Sherman, and a "Love-Letter of Alexander Hamilton, written to Elizabeth Schuyler a few Weeks before their Marriage," in 1780; and an informing contribution on "Archæology in Missouri," — close the number.

— Messrs. P. Blakiston, Son, & Co. have issued a second edition of Leffmann & Beam's "Examination of Water for Sanitary and Technical Purposes." Since the publication of the first edition, many processes for water-analysis have been proposed, and these have been included in the present revision, so far as they seemed to be of substantial value. The authors particularly mention among these new methods those recommended by the chemical section of the American Association, and the application of the Kjeldahl process to the determination of organic nitrogen. The section on biological examinations has been considerably extended; and the authors believe that while it would be impossible to overestimate the importance of bacteriology in certain departments of science, yet that until pathogenic microbes are more nearly indicated and described the methods will be of little use in dealing with the problem of the determination of the sanitary and technical value of water-supplies. A chapter is devoted to the purification of water, in which are described in some detail the more important systems.

— The Ocean Steamship Series begins in the April number of *Scribner's Magazine*. The following articles have been arranged for, all to be fully illustrated: "Ocean Passenger Travel," by John H. Gould; "The Ship's Company," by Lieut. J. D. Jerrold Kelly, U.S.N.; "Safety at Sea," by W. H. Rideing; "Speed in Ocean Steamships," by A. E. Seaton; and "Ocean Steamship Lines of the World."

— Messrs. Longmans, Green, & Co. have issued Hjelt's "Principles of General Organic Chemistry," translated by J. Bishop Tingle. This book is intended for students who have some general knowledge of organic chemistry, and who wish to extend and systematize that knowledge. Part I. is devoted to the composition, constitution, and classification of organic compounds; Part II., to illustrating the connection between the constitution of such compounds and their chief physical properties; and Part III. deals with the chemical behavior of organic compounds. The book is intended as a supplement to, rather than as a substitute for, ordinary text-books.

— A book that will be useful in the laboratory of many scientific men has recently been published by Norman W. Henley, New York, entitled "Rubber Hand Stamps and the Manipulation of Rubber." The author is T. O'Conor Sloane, Ph.D. The object of the book is to present in simple form the methods of manipulation of India-rubber. To mould and cure the mixed gum, but few appliances are needed, and these can be made at home. For some reason the methods of moulding the material are not generally known; and while the futility of attempting to melt and cast it has been taught many by sad experience, yet India-rubber is the most plastic of materials when properly treated.

— A cable despatch to the *Publishers' Weekly*, dated Paris, March 24, says, "M. Aulard, professor of history at the Sorbonne, impeaches the authenticity of the 'Talleyrand Memoirs.' He argues, that from internal evidence, parts of the papers have been suppressed, and that the gaps have been clumsily concealed. He suggests that the work was done by Bacourt to screen the reputation of Talleyrand or of royal personages, as the published version of the memoirs does not account for the prohibition of their publication for so many years. The Duc de Broglie gives an evasive reply to M. Aulard's challenge to produce the original manuscript."

— Professor Knoflach publishes through G. E. Stechert his "Sound-English Primer," in which he applies the methods of his former book, "Sound-English: The Language of the World," although he has much simplified his system of types and turned letters, and now uses only the accepted English lettering. The little stories of which the primer consists are first printed in phonetic spelling, and are then given in regular spelling, that the child may learn to reason and understand the different combinations of sound made by the different combinations of letters. The author thinks children will learn to read by this new method in less than half the time now required.

— "How to meet Hereditary Physical Traits in Children" is the subject of a series of brief papers begun in *Babyhood* for April. Other articles in this number are "Tuberculous Joint Diseases in Children," and "Objects and Methods of the Bath." Minor topics are, "Disturbed Sleep," "Early Singing," "Quality of the Teeth," "Hives," etc.

— One of the most recent of the Elementary Science Manuals, published by Longmans, Green, & Co., is "Practical, Plane and Solid Geometry," by I. H. Morris. Among the special features of the work, the following may be mentioned. The subject is so arranged that, as far as possible, similar problems are grouped together; the diagrams face the text relating to them; a very large number of examples are fully worked out; the notes are numerous; and there are an abundance of exercises appended. These exercises, which are carefully selected, are nicely graduated; and hints for solution, and references to the problems upon which they depend, are given. The concluding chapter of the book is devoted to graphic arithmetic.

INDUSTRIAL NOTES.

The Crocker-Wheeler Motors.

THE Crocker-Wheeler Electric Motor Company of this city are now turning out a line of motors which, in point of excellence, both mechanically and electrically, leave little to be desired in the present stage of electrical development. These motors are so designed and constructed that they do their rated work at a much slower speed than has been possible heretofore, and without the hitches and troubles frequently incident to the use of electrical machinery.

In the accompanying illustrations, Fig. 1 is a skeleton view showing the construction of a motor of small size, one-horse-power and under. Figs. 2 and 3 show an indestructible resistance-box, made entirely of iron and slate, and used in starting, stopping, and regulating the speed of the motors.

The field-magnets are composed entirely of wrought iron, each being forged in a single piece and set deeply into the base, insuring ample magnetic contact, together with great solidity of construction.

The space for wire on the magnets is perfectly cylindrical, thereby insuring smooth and perfect winding of the wire, and is short in length, permitting the shaft of the machine to be low enough to free it from vibration. By this construction, the neutrality or freedom of the base from magnetism is secured, and there is no tendency to leakage, making the machine superior in this respect to those in which the base is made to serve as one of the pole-pieces.

The armatures contain several improvements. They are sufficiently large in diameter to obtain slow speed, and are so designed that the wire winding is entirely embedded below the surface of

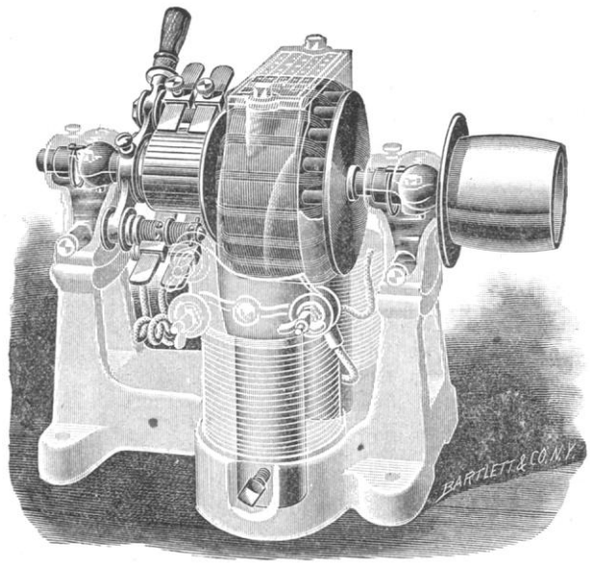

FIG. 1.

the iron core, thus protecting it from injury, holding it rigidly in position, and rendering it possible for the magnets to approach very closely to the core, so that an intense magnetic effect is pro-

duced. The armature is mounted upon a brass face-plate, which is first turned perfectly true, and after completion the armature is carefully balanced, so that when run at full speed the motion is hardly perceptible. The bearings are all of the self-oiling type,

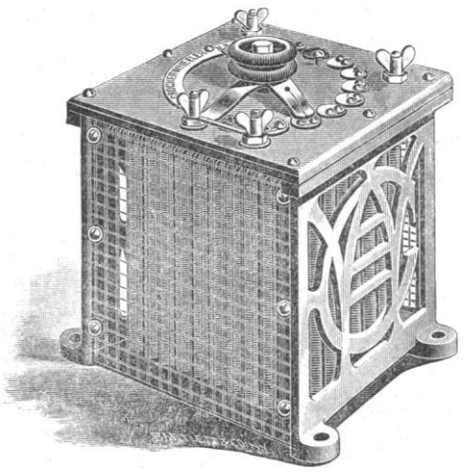

FIG. 2.

which do not require attention oftener than once in two to four weeks.

In the regulator, the arrangement of contacts in the switch on top is such that both the field and armature of the motor are charged by the single operation of turning the knob, making it impossible to put the current on the armature before the field is charged, which has often been the cause of the burning-out of motors by the use of ordinary regulators. The field is first charged through a small resistance-coil, which is put in for the purpose of preventing a too sudden change in the magnetic strength of the latter, as well as to divide the spark when the motor is disconnected. The coils used for starting the armature are all of the same size wire, carefully tried for carrying the full current of the machine at all speeds. With the fire-proof regulator, the motor can therefore be slowed down and left running at any desired speed indefinitely; and the usual caution, "never to leave the box half turned on for fear of overheating and fire," is unnecessary. The capacity of these boxes is stamped upon them also, as it is on all apparatus made by the company.

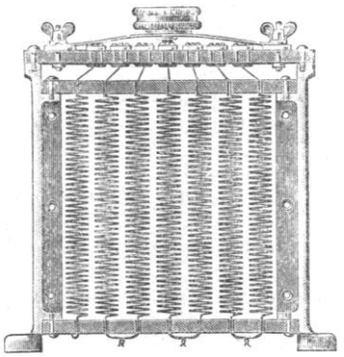

FIG. 3.